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Joseph F. Hetz - Reg. No. 41,070
Name of Applicant, Assignee or Registered Representative

Signature

Duplicate #18

Our Case No. 5050/296

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Ted Christopher	Examiner:	F. Jaworski
Serial No.:	08/746,360	Group Art Unit:	3700
Filed:	November 8, 1996		
For:	Finite Amplitude Distortion-Based Inhomogeneous Pulse Echo Ultrasonic Imaging		

Assistant Commissioner for Patents
Washington, D.C. 20231

ATTENTION: DIRECTOR OF GROUP 3700

PROTEST UNDER 37 CFR 1.291 (a)

Sir:

Enclosed is a copy of an article by B. Schrope, V.L. Newhouse, and V. Uhlendorf entitled "Simulated Capillary Blood Flow Measurement Using a Nonlinear Ultrasonic Contrast Agent" ("the Uhlendorf article") and a copy of U.S. Patent No. 5,724,976 to Mine et al. ("the Mine patent"). Also enclosed is published PCT application number WO 98/20361 ("the PCT application"), which claims priority to the above-identified patent application ("the Christopher application"). Protestor requests that the Uhlendorf article and the Mine patent be reviewed during the examination of the Christopher application.

This Protest contains two sections. The first section highlights portions of the Uhlendorf article that may be relevant to the claims in the Christopher application that are similar to any of Claims 8, 16, and 21-22 in the PCT application. The second section compares the remaining claims in the PCT application with selected portions of the Mine patent.

I. The Uhlendorf Article

Protestor requests that the claims in the Christopher application, particularly those that are similar to any of Claims 8, 16, and 21-22 in the PCT application, be examined in view of the Uhlendorf article. As shown in Table I on page 148 and in the following passages, the Uhlendorf article teaches that a second harmonic response can be generated by tissue:

"It must be emphasized that the nonlinear propagation of an acoustic wave through a material is not the same phenomenon as the nonlinearity generated by bubbles in an acoustic field. Nonlinear propagation of an acoustic wave is due to the fact that the velocity of propagation of a finite-amplitude sound wave varies with pressure. As the pressure increases, the velocity of the sinusoidal wave is greater at the pressure maximum than it is at the pressure minimum. This leads to a continuous distortion of the wave, resulting in the generation of harmonics of the source frequency in the medium. This nonlinearity may be characterized by the dimensionless B/A parameter, which relates the pressure amplitude of the fundamental frequency with the pressure amplitude of the second harmonic frequency. For liquids such as water and for many biological tissues, B/A ranges from 5.5 to 11. For bubbly media, however, values of B/A on the order of 10^4 or 10^5 have been reported [7]. Thus, we can expect a much more strongly nonlinear scattered wave from bubbly suspensions (such as contrast agents containing "free" air bubbles) than from either the water medium by itself or from biological tissue" (page 137, last paragraph).

"Using a nonlinear contrast agent and analyzing the second harmonic component of the echo, however, would greatly improve the signal-to-clutter ratio and differentiate blood flow echoes from tissue motion echoes. Analysis to follow shows that the nonlinearity produced by propagation through the tissue is negligible compared to that produced by the contrast agent in the capillaries; thus, echoes from surrounding tissue clutter and vasomotion are virtually eliminated" (page 138-139).

"It is evident then that our presumption that the contrast agent has stronger scattering than tissue at the nonlinear second harmonic is verified" (page 145, last paragraph).

"In addition, the acoustic properties of the tissue must be modeled. These properties are, of course, scattering and attenuation, and, due to the special circumstances in this measurement, tissue nonlinearity (B/A). . . . To estimate the nonlinear response from tissue, we use Eq. (4) and assume a typical value of B/A for a soft tissue such as muscle of 7.2 [13]; hence, under the experimental circumstances given above, the second harmonic component, σ_{t2}, is found to be $2x10^{-5}$ m^{-3}" (page 146-47).

"We must also recognize that the tissue itself will generate some harmonic distortion on both transmit and receive" (page 148, second full paragraph).

"For the same muscle tissue, we would expect some conversion of the fundamental frequency to the second harmonic via nonlinear propagation through the tissue. . . . This corresponds to a scattering cross section of $\sigma_{t2}=3.59x10^{-4}$ m^{-3}, still quite significantly less than that of the contrast agent, $\beta\sigma_{c2}=0.0227$ m^{-3} (see table 1 for comparison of all calculated values). The results of this analysis are encouraging for further study into the

problem. The amplitude of the second harmonic component of the backscattered signal, even from very small relative volumes, is powerful enough (i.e., much stronger than the tissue echo) to be recognized as signal from contrast agent" (page 149, second and third full paragraphs).

Protestor further requests that the Uhlendorf article be considered along with the material presented in Protestor's Petition for the Institution of a Public Use Proceeding, filed March 20, 1998 ("the Public Use Petition"). The Public Use Petition includes evidence that ultrasound images of heart tissue, acquired at the second harmonic of the fundamental transmission frequency in the absence of added contrast agent, were in public use in the United States in March of 1993, June of 1993, and September of 1994. These images included tissue harmonic signal resulting from second harmonic distortion of the fundamental ultrasound beam as it propagated through the tissues of the animal subject.

II. The Mine Patent

Because the Mine patent describes several embodiments, Protestor provides the following comparison of the claims in the PCT application with selected portions of the Mine patent. To the extent that the claims in the PCT application are similar to the claims in the Christopher application, this comparison may facilitate the review of the Mine patent.

A. Claims 1-6 and Claims 9-14

1. Claims 1-2 and Claims 9-10

The PCT Application	The Mine Patent
1. A method of imaging a sample comprising the steps of:	"A diagnostic ultrasound system of the first embodiment implements contrast echography to efficiently detect a second harmonic that is a non-fundamental component produced due to nonlinear scattering caused by a foam contained in an ultrasound contrast medium, and then two-dimensionally display a second-harmonic distribution image" (col. 6, lines 36-43).
generating an ultrasonic signal;	"The transmission system . . . generates . . . driving pulses" (col. 9, lines 21-33).
directing the ultrasonic signal into a sample,	"[U]ltrasound beams each having the fundamental component f alone are irradiated to a desired diagnostic region of a subject" (col. 10, lines 31-33).

wherein the sample reflects the signal;	"[E]ach of echoes [sic] consists mainly of scattered components induced by a tissue and the ultrasound contrast medium" (col. 10, lines 35-37)..
receiving the signal reflected by said sample, which received signal is distorted and contains a first order and higher order component signals at first and higher frequencies respectively;	"Since an ultrasound contrast medium is flowing into or out from the diagnostic region by means of blood, each of echoes [sic] consists mainly of scattered components induced by a tissue and the ultrasound contrast medium; that is, nonlinear scattered components including a second harmonic induced by the contrast medium are included in each echo (col. 10, lines 33-39).
forming an image from one of said higher order component signals of the received distorted signal, including the step of removing from the received distorted signal the first order component thereof; and	"The second harmonic 2f alone of each echo is extracted by the HPF [high-pass filter] circuit . . . . This results in a contrast-mode B-mode image signal deriving from the second harmonic stemming from nonlinear scattering caused by a contrast medium" (col. 10, lines 57-61).
displaying said formed image.	"The image signal is displayed" (col. 10, lines 61-62).
2. A method according to Claim 1, wherein the removing step includes the step of high-pass filtering the received, reflected distorted signal to remove therefrom the first order component thereof.	"The second harmonic 2f alone of each echo is extracted by the HPF [high-pass filter] circuit . . . . This results in a contrast-mode B-mode image signal deriving from the second harmonic stemming from nonlinear scattering caused by a contrast medium" (col. 10, lines 57-61).

Claims 9-10 are system claims that recite elements similar to those of Claims 1-2 in a different form.

2. Claims 3-6 and 11-14

Protestor requests that Claims 3-6 and 11-14 be examined in view of the above chart and in view of U.S. Patent No. 5,577,505 to Brock-Fisher et al. As the Examiner may be aware, Brock-Fisher et al. has been cited as a Category X reference in the PCT application. As stated in the Summary of the Invention, Brock-Fisher et al. discloses measuring an ultrasound response under multiple excitation levels. The responses gathered are gain corrected in an amount corresponding to the difference in excitation levels and then subtracted to remove most of the linear response.

B. Claims 7 and 15

Protester requests that Claims 7 and 15 be examined in view of the above chart and notes that the Mine patent states that the "nonlinear scattered components including a second harmonic

induced by the contrast medium are included in each echo" (col. 10, lines 37-39) and that the "image signal [deriving from the second harmonic] is displayed" (col. 10, lines 61-62).

C. Claims 17 and 19

Protester requests that Claims 17 and 19 be examined in view of the above chart and notes that the statements quoted from the Mine patent are in the context of a series of ultrasonic pulse signals.

D. Claims 18 and 20

Protester requests that Claims 18 and 20 be examined in view of the above chart and notes that the method and system described in the Mine patent are directed to imaging a blood-perfused region in the cardiac muscle (col. 10, lines 63-65).

III. Conclusion

Protestor requests that this Protest and the enclosed references be considered during the examination of the Christopher application. Protestor has a potential interest in acquiring rights in any patent maturing from the Christopher application and wishes to have this Protest considered carefully by the Patent Office.

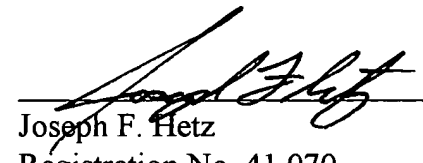
Additionally, Protestor hereby certifies that a duplicate copy of this Protest has been sent to Research Corporation Technologies, the owner of the Christopher application, by first class mail on August 13, 1998 at the following address:

Mr. Timothy Reckart, Esq.
General Counsel, Secretary and Director of Legal Affairs
Research Corporation Technologies
101 North Wilmot Road, Suite 500
Tucson, Arizona 85711-3335

Dated: August 13, 1998

Respectfully submitted,

ACUSON CORPORATION



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